UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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MEMORANDUM

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QA REVIEWER: Susan Carrell, Washington State Department of Ecology _____

SUBJECT: Narrative for analysis of samples collected for the Burlington Hill Project

Project Code: SFP-043A
Account Code: 13T10P303DD210ZZLA00

The following pertains to the quality assurance (QA) documentation associated with the asbestos analysis by stereomicroscope and polarized light microscopy (PLM) of six bulk samples collected during the Burlington Hill sampling event. I supplemented the PLM analysis with additional analysis I conducted with a scanning electron microscope (SEM) and energy dispersive spectroscopy (EDS) and x-ray diffraction (XRD) which I will discuss in a separate narrative report.

I conducted the PLM analysis using the U.S. EPA Region 10 standard operating procedure (SOP) for analysis of asbestos in soils - ASB_003, and the California Air Resources Board (CARB) method 435. I conducted the SEM/EDS analysis using the U.S. EPA Region 10 SOP for asbestos analysis by SEM/EDS – ASB_004. For those tests for which the U.S. EPA Region 10 Laboratory has been accredited by the National Environmental Laboratory Accreditation Conference (NELAC), all requirements of the current NELAC Standard have been met.

The following comments refer to the quality control specifications for analysis of the following samples:

Field Identification Number	Laboratory Sample Number	Description
12090101	12394051	Location 1- West
19090103	12394053	Location 1 - East
12090106	12394056	Location 2 - South of Driveway
19090108	12394058	Location 2 - South of Garage
12090110	12394060	Location 3 – North End Quarry
19090113	12394063	Location 4 – North End

1.0 Holding time, Chain of Custody, and Sample Description

There is no recommended holding time for materials analyzed for asbestos. The six samples were contained within zip lock bags and I received them at the EPA Region 10 Laboratory for asbestos analysis on October 2, 2012. I completed the analysis of samples by PLM on November 27, 2012 and the supplemental analysis by SEM/EDS on December 6, 2012.

2.0 Results of Analysis

I have summarized the results of analysis in Table 1. I detected the mineral actinolite in two of the samples (12394051 and 12394053). The actinolite occurs in various morphologies including elongated acicular to bladed structures. Many of the elongated actinolite structures have aspect ratios (length to width) greater than 3:1 and length greater than 5 micrometers (μm). The ends of larger structures have a broken appearance rather than the splayed ends typical of asbestos. The optical properties for the elongated actinolite structures included oblique extinction (5^o to 17^o) and a positive sign of elongation with moderate birefringence. I estimated the average refractive index for $\alpha = 1.619$ and $\gamma = 1.644$ based on the Su method.[1] Example images of mineral structures analyzed by PLM are appended to this report.

In addition to actinolite, I identified mica and chlorite, which both occur as platy or lamellar structures. I did not detect actinolite in samples 12394056, 12394058, 12394060, and 12394063. I was able to identify mica, chlorite and quartz in these samples.

Table 1 – Summary of results of analysis

Sample No.	Sample Description	PLM	XRD[1]	SEM/EDS	Asbestos Type Mineral Detected	Quantity (%)	Qualifier	Comments
12394051	Green rock with white	X	X	X	actinolite	20		Point Count
12394053	Green rock	X		X	actinolite	15.75		Point Count
12394056	Brown/Black rock	X	X	X	ND	ND	A	
12394058	Brown/Black rock	X		X	ND	ND	A	
12394060	Black rock w/ grey coating	X	X	X	ND	ND	A	
12394063	Black to grey rock with tan coating	X		X	ND	ND	A	

[1] XRD data presented in a separate narrative report.

The ideal chemistry for the mineral actinolite is $Ca_2 (Mg, Fe)_5 Si_8 O_{22} (OH)_2$, although aluminum can substitute for silicon.[2] Analysis of samples 12394051 and 12394053 by SEM/EDS revealed that elongated structures were composed of O, Mg, Si, Ca, Fe and in some cases a minor concentration of Al typical of calcium magnesium silicates such as actinolite. The morphology of the elongated actinolite structures appeared mostly bladed or as blocky rods. Copies of example images and EDS spectra are appended to this report.

3.0 Sample Preparation

I prepared the samples for analysis by lightly grinding them with the aid of a corundum mortar and pestle. I prepared several slides for PLM analysis by taking a small aliquot (pinch) of sample and mounting it onto a glass slide in a drop of appropriate refractive index liquid. I also prepared samples for analysis by SEM/EDS by mounting a pinch sample on an adhesive carbon tab affixed to an aluminum SEM stub. I coated each of the sample stubs with a light layer of laboratory grade carbon with the aid of a Cressington108 Auto Carbon Coater.

4.0 Asbestos Measurement System Calibration

I performed calibration for the PLM and refractive index liquids as required using appropriate methods and procedures. I checked the PLM daily to verify Köhler illumination and aligned the crosshair reticle using an anthophyllite reference slide. I verified that the values for the refractive index liquids used for this project were accurate on April 4, 2012, using an Abbe refractometer.

I performed a spectrum calibration on the EDS on October 15, 2012, just prior to starting analysis of this sample set. On December 10, 2012, an EDAX service technician performed another spectrum calibration as part of the annual preventative maintenance visit. In both cases, the EDS performed according to specifications.

5.0 Analytical Procedures

I analyzed samples for this project according to the U.S. EPA Region 10 SOP for analysis of asbestos in soils - ASB_003, and the California Air Resources Board (CARB) method 435. I performed PLM analysis using a Carl Zeiss Axioskop 40 PLM with a crosshair reticle mounted in the microscope ocular. The magnification range for the Carl Zeiss Axioskop 40 PLM is 100 times (x) to 400x and 100x for dispersion staining.

Determination of asbestos involves evaluation of the morphology and optical properties of suspected asbestos structures with an aspect ratio greater than 3:1. The raw data prepared for this project documents the gross sample description, stereomicroscopic observations, and optical properties observed by PLM including fiber morphology, extinction angle, sign of elongation, birefringence, and central-stop dispersion staining characteristics in appropriate refractive index liquids. The percent concentration of asbestos is based on gravimetry and a 400-point count of asbestos fibers and/or fiber bundles using the following formula:

$$\% \text{ asbestos} = (a/n)\ (100\%)$$

The letter “a” is equal to the number of points occupied by an asbestos fiber or structure, and the letter “n” is equal to the number of points occupied by either asbestos or non-asbestos material.

I also analyzed the samples by SEM/EDS according to the U.S. EPA Region 10 SOP for asbestos analysis by SEM/EDS – ASB_004.

6.0 Quality Assurance and Quality Control

I reviewed a set of commercially prepared slides as standardized references. I also analyzed, by both PLM and SEM/EDS, a specimen of actinolite asbestos standard reference material (SRM) 1867a obtained from the National Institute of Standards and Technology (NIST). During PLM analysis, method blanks were prepared daily to determine that refractive index liquid and tools used for this project were asbestos-free. All supplies and tools were determined to be asbestos-free.

I used multiple analytical techniques (PLM, XRD, SEM/EDS) to analyze samples for this project. The qualitative results of analysis between techniques verified the presence of actinolite in samples 12394051 and 12394053.

7.0 Reporting Limits / Data Qualifiers

The detection limit for asbestos minerals by PLM using CARB 435 is 0.25%. The quantitative sample results for this project are reported as a percentage based point counting by PLM. If the component is present but no percentage is reported, the qualifier for present but not quantified (PNQ) is used. If the component is not present, the qualifier for absent (A) is used. If the component is positively identified but is estimated to be less than 0.25%, the qualifier used is trace (T).

8.0 References

[1] Su, Shu-Chun (1996) *Rapidly and Accurately Determining Refractive Indices of Asbestos Fibers Using the Dispersion Staining Method*. Wilmington, Delaware: Hercules Incorporated.

[2]Deer, W.A., Howie, R.A., and Zussman, J. (1992) An introduction to the Rock Forming Minerals, 2nd edition, pg 226-247.